

1. Let $S = \left\{ x \in [-6, 3] - \{-2, 2\} : \frac{|x+3|-1}{|x|-2} \geq 0 \right\}$

and $T = \{x \in \mathbb{Z} : x^2 - 7|x| + 9 \leq 0\}$. Then the number of elements in $S \cap T$ is :

- a) 7
- b) 5
- c) 4
- d) 3

2. Let R_1 and R_2 be relations on the set $\{1, 2, \dots, 50\}$ such that

$R_1 = \{(p, p^n) : p \text{ is a prime and } n \geq 0 \text{ is an integer}\}$
and $R_2 = \{(p, p^n) : p \text{ is a prime and } n = 0 \text{ or } 1\}$.

- a) 8
- b) 9
- c) 10
- d) 12

3. The domain of the function

$$f(x) = \sin^{-1}[2x^2 - 3] + \log_2(\log_{1/2}(x^2 - 5x + 5)),$$

where $[t]$ is the greatest integer function, is

- a) $\left(-\frac{\sqrt{5}}{2}, \frac{5-\sqrt{5}}{2}\right)$
- b) $\left(\frac{5-\sqrt{5}}{2}, \frac{5+\sqrt{5}}{2}\right)$

c) $\left(1, \frac{5-\sqrt{5}}{2}\right)$

d) $\left(1, \frac{5+\sqrt{5}}{2}\right]$

4. If $2\sin^3 x + \sin 2x \cos x + 4\sin x - 4 = 0$ has exactly 3 solutions in the interval

$$\left[0, \frac{n\pi}{2}\right], n \in \mathbb{N}, \text{ then the roots of the}$$

equation $x^2 + nx + (n-3) = 0$ belong to

a) $(0, \infty)$

b) $(-\infty, 0)$

c) $\left(-\frac{\sqrt{17}}{2}, \frac{\sqrt{17}}{2}\right)$

d) $\mathbb{Z}$

5. The area (in sq. units) of the region

$$S = \{z \in \mathbb{C} : |z-1| \leq 2; (z+\bar{z}) + i(z-\bar{z}) \leq 2, \operatorname{Im}(z) \geq 0\}$$

is

a) $\frac{7\pi}{4}$

b) $\frac{3\pi}{2}$

c) $\frac{7\pi}{3}$

d) $\frac{17\pi}{8}$

6. The set of values of x which satisfy the

inequations $5x + 2 < 3x + 8$ and $\frac{x+2}{x-1} < 4$ is

- a) $(-\infty, 1)$
- b) $(2, 3)$
- c) $(-\infty, 3)$
- d) $(-\infty, 1) \cup (2, 3)$

7. Three married couples are to be seated in a row having six seats in a cinema hall. If spouses are to be seated next to each other, in how many ways can they be seated? Find also the number of ways of their seating if all the ladies sit together.

- a) 40, 140
- b) 48, 144
- c) 45, 142
- d) 42, 140

8. If $\sum_{k=1}^{31} \binom{31}{k} \binom{31}{k-1} - \sum_{k=1}^{30} \binom{30}{k} \binom{30}{k-1} = \frac{\alpha(60!)}{(30!)(31!)}$ where $\alpha \in R$, then the value of 16α is equal to

- a) 1411
- b) 1320
- c) 1615
- d) 1855

9. If $(1+x-3x^2)^{10} = 1 + a_1x + a_2x^2 + \dots + a_{20}x^{20}$, then the expression $a_2 + a_4 + a_6 + \dots + a_{20}$ is equal to

- a) $\frac{3^{10} + 1}{2}$
- b) $\frac{3^9 + 1}{2}$
- c) $\frac{3^{10} - 1}{2}$
- d) $\frac{3^9 - 1}{2}$

10. $(C_0 + C_1)(C_1 + C_2) \dots (C_{n-1} + C_n)$ is equal to

- a) $(C_0 C_1 C_2 \dots C_{n-1}) (n+1)$
- b) $(C_0 C_1 C_2 \dots C_{n-1}) (n+1)^n$
- c) $\frac{(C_0 C_1 C_2 \dots C_{n-1}) (n+1)^n}{n!}$
- d) None of these

11. Fill in the blanks.

(i) If 25^{15} is divided by 13, then the remainder is P.

(ii) The coefficient of x in the expansion of $(1-3x+7x^2)(1-x)^{16}$ is Q.

(iii) ${}^{21}C_0 + {}^{21}C_1 + {}^{21}C_2 + \dots + {}^{21}C_{10} = R$.

(iv) The number of terms in the expansion of $[(2x+y^3)^4]^7$ is S.

P	Q	R	S
a) 14	-15	2^{20}	29
b) 14	-15	2^{10}	18
c) 12	-19	2^{10}	29
d) 12	-19	2^{20}	29

12. The minimum value of $8^{\sin(x/8)} + 8^{\cos(x/8)}$ is :

- a) $2^{\frac{1}{3-\sqrt{2}}}$
 b) $2^{\frac{-3+\sqrt{2}}{\sqrt{2}}}$
 c) $2^{\frac{1}{3+\sqrt{2}}}$
 d) $2^{\frac{3-\sqrt{2}}{\sqrt{2}}}$

13. Which of the following statements is INCORRECT ?

- (a) If S_1, S_2, S_3 are the sum of first n natural numbers, their squares and their cubes, respectively, then $7S_2^2 = S_3(1 + 8S_1)$.
 (b) A farmer buys a used tractor for Rs.12000. He pays Rs. 6000 cash and agrees to pay the balance in annual installments of Rs. 500 plus 12% interest on the unpaid amount. The tractor will cost him for Rs. 16680.

(c) If the p^{th} and q^{th} terms of a G.P. are q and p

respectively, then its $(p + q)^{\text{th}}$ term is $\left(\frac{q^p}{p^q}\right)^{\frac{1}{p-q}}$.

(d) None of these

14. The sum $\sum_{n=1}^{\infty} \frac{2n^2 + 3n + 4}{(2n)!}$ is equal to

- a) $\frac{11e}{2} + \frac{7}{2e} - 4$
 b) $\frac{11e}{2} + \frac{7}{2e}$
 c) $\frac{13e}{4} + \frac{5}{4e} - 4$
 d) $\frac{13e}{4} + \frac{5}{4e}$

15. Consider the lines $L_1 \equiv x + 3y - 7 = 0$ and $L_2 \equiv 3x - y - 1 = 0$ Which of the following statements is/are true?

- (a) L_1 and L_2 are perpendicular to each other.
 (b) The point of intersection of L_1 and L_2 is $(1, 2)$.
 (c) The image of the point $(3, 8)$ w.r.t. the line L_1 assuming L_1 to be plane mirror is $(-1, -4)$.
 (d) All of these

16. The straight lines L_1 and L_2 pass through the origin and trisect the line segment of the line $L : 9x + 5y = 45$ between the axes. If m_1 and

m_2 are the slopes of the lines l_1 and l_2 then the point of intersection of the line $y = (m_1 + m_2)x$ with L lies on

- a) $y - x = 5$
- b) $6x + y = 10$
- c) $y - 2x = 5$
- d) $6x - y = 15$

17. Let $G(\alpha, \beta)$ be the circumcentre of the triangle formed by the lines : $4x + 3y = 69$, $4y - 3x = 17$ and $x + 7y = 61$. Then $(\alpha - \beta)^2 + \alpha + \beta$ is equal to

- a) 16
- b) 17
- c) 18
- d) 15

18. If the foci of the ellipse $\frac{x^2}{9} + \frac{y^2}{16} = 1$ are $(0, \sqrt{7})$ and $(0, -\sqrt{7})$, then the foci of the

ellipse $\frac{x^2}{9+t^2} + \frac{y^2}{16+t^2} = 1, t \in R$, are

- a) $(0, \sqrt{7}), (0, -\sqrt{7})$
- b) $(0, 7), (0, -7)$
- c) $(0, 2\sqrt{7}), (0, -2\sqrt{7})$
- d) $(\sqrt{7}, 0), (-\sqrt{7}, 0)$

19. State T for true and F for false.

(i) The equation of the circle having centre at $(3, -4)$ and touching the line $5x + 12y - 12 = 0$ is $(x-3)^2 + (y+4)^2 = \left(\frac{45}{13}\right)^2$.

(ii) The equation of the circle circumscribing the triangle whose sides are the lines $y = x + 2$, $3y = 4x$, $2y = 3x$ is $x^2 - y^2 - 46x + 22y = 0$

(iii) The equation of the parabola having focus at $(-1, -2)$ and directrix is $x - 2y + 3 = 0$ is $x^2 + y^2 + 3x + 32y + 4xy + 16 = 0$

	(i)	(ii)	(iii)
a)	F	F	F
b)	F	T	F
c)	F	F	T
d)	T	F	F

20. The equations of two sides of a variable triangle are $x = 0$ and $y = 3$, and its third side is a tangent to the parabola $y^2 = 6x$. The locus of its circumcentre is

- a) $4y^2 - 18y + 3x + 18 = 0$
- b) $4y^2 - 18y - 3x + 18 = 0$
- c) $4y^2 + 18y + 3x + 18 = 0$
- d) $4y^2 - 18y - 3x - 18 = 0$

21. $\lim_{n \rightarrow \infty} \frac{[x] + [2x] + \dots + [nx]}{n^2}$ where $[.]$ denotes the

greatest integer function, is equal to

a) $\frac{x}{2}$

b) x

c) $2x$

d) None of these

22. $\lim_{n \rightarrow \infty} \frac{(1^2 - 1)(n - 1) + (2^2 - 2)(n - 2) + \dots + ((n - 1)^2 - (n - 1)) \cdot 1}{(1^3 + 2^3 + \dots + n^3) - (1^2 + 2^2 + \dots + n^2)}$

is equal to :

a) $\frac{3}{4}$

b) $\frac{1}{3}$

c) $\frac{1}{2}$

d) $\frac{2}{3}$

23. Let $x = 2$ be a root of the equation $x^2 + px + q = 0$ &

$$f(x) = \begin{cases} \frac{1 - \cos(x^2 - 4px + q^2 + 8q + 16)}{(x - 2p)^4} & , x \neq 2p \\ 0 & , x = 2p \end{cases}$$

Then $\lim_{x \rightarrow 2p^+} [f(x)]$, where $[.]$ denotes

greatest integer function, is

a) 2

b) 1

c) -1

d) 0

24. The mean deviation of items $x, x+y, x+2y, \dots, x+2ny$ from mean is

a) $\frac{n(n+1)y}{2n+1}$

b) $\frac{(n+1)y}{2n+1}$

c) $\frac{ny}{2n+1}$

d) $\frac{(2n+1)y}{n(n+1)}$

25. Let the mean and variance of 12

observations be $\frac{9}{2}$ and 4 respectively. Later

on, it was observed that two observations were considered as 9 and 10 instead of 7

and 14 respectively. If the correct variance

m/n where m and n are coprime, then $m + n$

is equal to

a) 314

b) 315

c) 317

d) 316

26. Three natural numbers are taken at random from a set of numbers $\{1, 2, \dots, 50\}$. The probability that their average value taken as 30, equals

a) $\frac{{}^{30}C_2}{{}^{89}C_2}$

b) $\frac{{}^{89}C_2}{{}^{50}C_{47}}$

c) $\frac{{}^{89}C_{85}}{{}^{50}C_3}$

d) None of these

27. A box contains 100 bolts and 50 nuts. It is given that 50% bolts and 50% nuts are rusted. Two objects are selected from the box at random. Find the probability that either both are bolts or both are rusted.

a) 0.44

b) 0.58

c) 0.52

d) 0.48

28. Let the sum of two positive integers be 24. If the probability, that their product is not less than $\frac{3}{4}$ times their greatest possible product, is $\frac{m}{n}$, where $\gcd(m, n) = 1$, then $n - m$ equals

a) 9

b) 10

c) 11

d) 8

29. If $z \neq 0$ be a complex number such that

$$\left| z - \frac{1}{z} \right| = 2, \text{ then the maximum value of } |z| \text{ is :}$$

a) $\sqrt{2}$

b) 1

c) $\sqrt{2} - 1$

d) $\sqrt{2} + 1$

30. If $8\cos 2\theta + 8\sec 2\theta = 65$, $0 < \theta < \pi/2$, then the value of $4\cos 4\theta$ is equal to

a) $-\frac{33}{8}$

b) $-\frac{31}{8}$

c) $-\frac{31}{32}$

d) $-\frac{33}{32}$

31. In a certain code language, HUNTER is written as ELQWDU. How is MASTER written in that code?

A) PZVWDU

B) JYWTDU

C) HYVQDU

D) LZUTDU

32. Pointing to a woman in a photograph, Ajay says, "She is the daughter of my father's only sister." How is the woman related to Ajay?

A) Cousin

B) Sister

C) Aunt

D) Niece

33. A person starts walking from point A. He walks 7 km east, then turns left and walks 9 km, then turns left again and walks 5 km. Finally, he turns left and walks 9 km. How far is he from the starting point?

A) 2 km

B) 4 km

C) 7 km

D) 5 km

34. In a row of students, Arjun is 15th from the left and 9th from the right. Four new students join the row, and they occupy positions to the left of Arjun. What is Arjun's new position from the left?

A) 19th

B) 16th

C) 15th

D) 18th

35. A cube is painted on all its faces. It is then cut into 64 smaller cubes of equal size. How many cubes have exactly two faces painted?

A) 12

B) 24

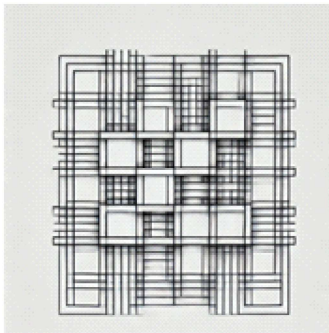
C) 16

D) 20

36. What will be the day of the week on 15th August 2080, if 1st January 2000 was a Saturday?

- A) Thursday
- B) Saturday
- C) Sunday
- D) Tuesday

37. In the following diagram, how many squares are there?



- A) 12
- B) 14
- C) 16
- D) 18

38. Statements:

1. No cat is a dog.

2. All dogs are animals.

Conclusions:

- 3. No cat is an animal.
- 4. Some animals are dogs.

Choose the correct option:

- A) Only conclusion 1 follows
- B) Only conclusion 2 follows
- C) Both conclusions follow
- D) Neither conclusion follows

39. Find the pair that exhibits the same relationship:

Mirror : Reflection :: Water : ?

- A) Transparency
- B) Image
- C) Refraction
- D) Shadow

40. Find the odd one out:

- A) 13
- B) 17
- C) 19
- D) 21

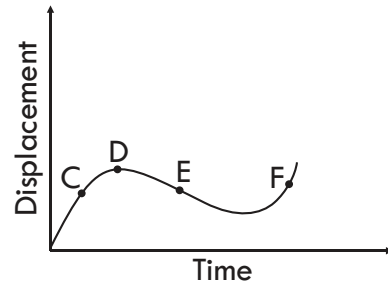
41. If P, Q, R are physical quantities, having different dimensions, which of the following combinations can never be a meaningful quantity ?

- a) $\frac{P-Q}{R}$
 (b) $PQ - R$
 c) $\frac{PQ}{R}$
 d) $\frac{PR-Q^2}{R}$

42. The time period of oscillations of a body is given by $T = 2\pi\sqrt{\frac{mGA}{K}}$, K represents the kinetic energy, m mass, g acceleration due to gravity and A is unknown. If $[A] = M^x L^y / T^z$; then what is the value of $x + y + z$?

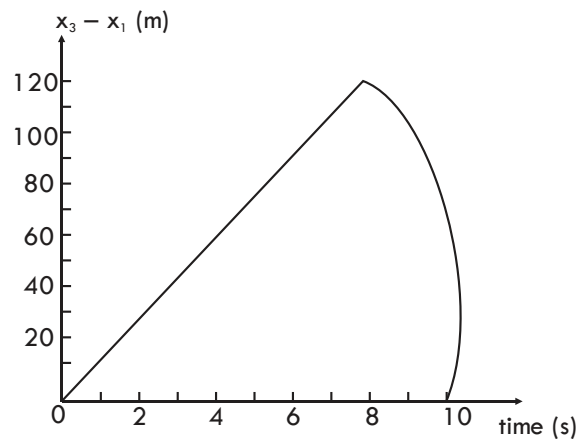
- a) 3
 b) 2
 c) 1
 d) 5

43. The displacement - time graph of a moving particle is as shown in the figure. The instantaneous velocity of the particle is negative at the point.



- a) C
 b) D
 c) E
 d) F

44. The stones are thrown up simultaneously from the edge of a cliff 200 m high with initial speeds of 15 m s^{-1} and 30 m s^{-1} respectively. The time variation of the relative position of the second stone with respect to the first is shown in the figure. The equation of the linear part is



- a) $x_2 - x_1 = 50t$
 b) $x_2 - x_1 = 10t$
 c) $x_2 - x_1 = 15t$
 d) $x_2 - x_1 = 20t$

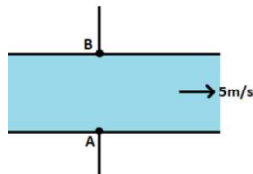
45. A police van moving on a highway with a speed of 30 km h^{-1} fires a bullet at a thief's car speeding away in the same direction with a speed of 192 km h^{-1} . If the muzzle speed of the bullet is 150 m s^{-1} , with what speed (in m s^{-1}) does the bullet hit the thief's car ?

a) 95
b) 105
c) 115
d) 125

46. On an open ground, a motorist follows a track that turns to his left by an angle of 60° after every 500 m. Starting from a given turn, the displacement of the motorist at the third turn is

a) 500 m
b) $500\sqrt{3} \text{ m}$
c) 1000 m
d) $1000\sqrt{3} \text{ m}$

47. A river is flowing from west to east with a speed 5 m s^{-1} . A swimmer can swim in still water at a speed of 10 m s^{-1} . If he wants to start from point A on south bank and reach opposite point B on north bank, in what direction should he swim?

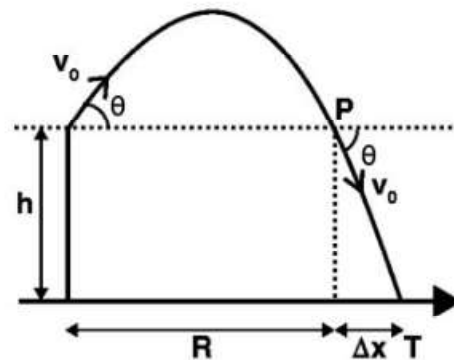


a) 30° east of north
b) 60° east of north
c) 30° west of north
d) 60° west of north

48. A gun can fire shells with maximum speed v_0 and the maximum horizontal range that

can be achieved is $R = \frac{v_0^2}{g}$. If a target farther

away by distance Δx (beyond R) has to hit with the same gun (see figure), then it could be achieved by raising the gun to a height at least



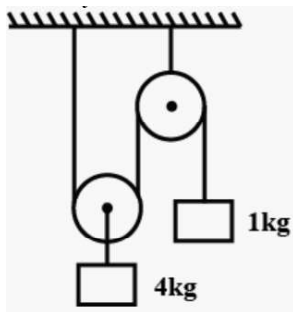
a) $h = \Delta x \left[1 + \frac{\Delta x}{R} \right]$
b) $h = \Delta x \left[1 - \frac{\Delta x}{R} \right]$
c) $h = \Delta x \left[1 + \frac{2\Delta x}{R} \right]$
d) $h = \Delta x \left[1 + \frac{\Delta x}{2R} \right]$

49. A Bullet is fired from a gun at the speed of 280 m s^{-1} in the direction 30° above the horizontal. The maximum height attained by the bullet is

$$(g = 9.8 \text{ m s}^{-2}, \sin 30^\circ = 0.5)$$

- a) 1000 m
- b) 3000 m
- c) 2800 m
- d) 2000 m

50. In the system shown in the figure, the acceleration of 1 kg mass is



- a) $\frac{g}{4}$ downwards
- b) $\frac{g}{2}$ downwards
- c) $\frac{g}{2}$ upwards
- d) $\frac{g}{4}$ upwards

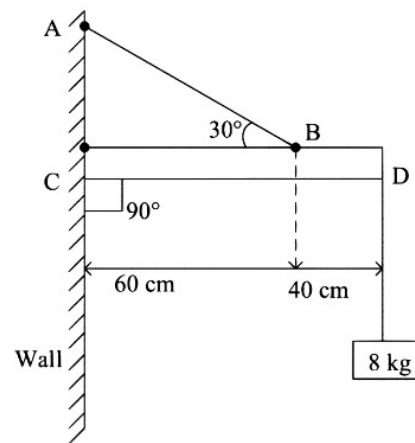
51. A cricket ball of mass 150 g has an initial velocity $\vec{u} = (3\hat{i} + 4\hat{j}) \text{ m s}^{-1}$ and a final

velocity $\vec{v} = -(3\hat{i} + 4\hat{j}) \text{ m s}^{-1}$ after being hit.

The change in momentum (final momentum – initial momentum) is (in kg m s^{-1})

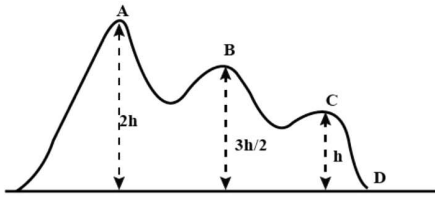
- a) zero
- b) $-(0.45\hat{i} + 0.6\hat{j})$
- c) $-(0.9\hat{i} + 1.2\hat{j})$
- d) $-5(\hat{i} + \hat{j})$

52. An object of mass 8 kg is hanging from one end of a uniform rod CD of mass 2 kg length 1 m pivoted at its end C on a vertical wall as shown in figure. It is supported by a cable AB such that the system is in equilibrium. The tension in the cable is (Take $g = 10 \text{ m/s}^2$)



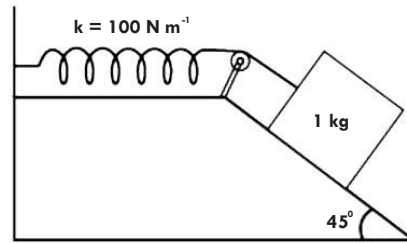
- a) 240 N
- b) 30 N
- c) 300 N
- d) 90 N

53. A small roller coaster starts at point A with speed u on a curved track as shown in the figure.



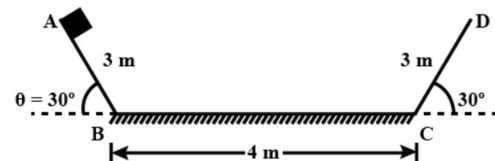
The friction between the roller coaster and the track is negligible and it always remains in contact at D on the track. It will be

- a) $(u^2 + gh)^{1/2}$
 b) $(u^2 + 2gh)^{1/2}$
 c) $(u^2 + 4gh)^{1/2}$
 d) u
54. A 1 kg block situated on a rough incline is connected to a spring of negligible mass having spring constant 100 N m^{-1} as shown in the figure. The block is released from rest with the spring in the unstretched position. The block moves 10 cm down the incline before coming to rest. The coefficient of friction between the block and the incline is (Take $g = 10 \text{ m s}^{-2}$) and assume that the pulley is frictionless)



- a) 0.2
 b) 0.3
 c) 0.5
 d) 0.6

55. A track has two inclined surfaces AB and DC each of length 3 m and angle of inclination of 30° with the horizontal and a central horizontal part of length 4 m as shown in the figure. A block of mass 0.2 kg slides from rest from point A. The inclined surfaces are frictionless. If the coefficient of friction between the block and the horizontal flat surface is 0.2, where will the block finally come to rest?



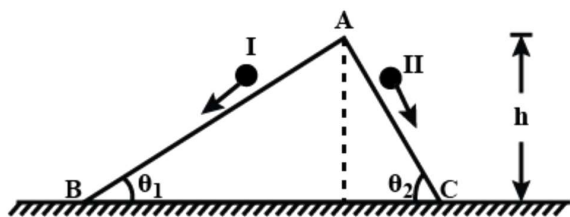
- a) 0.5 m away from point B
 b) 3.5 m away from point B
 c) 0.5 m away from point C
 d) 1.5 m away from point C

56. A particle in a certain conservative force field has a potential energy given by $V = \frac{20xy}{z}$.

The force exerted on it is

- a) $\left(\frac{20y}{z}\right)\hat{i} + \left(\frac{20x}{z}\right)\hat{j} + \left(\frac{20xy}{z^2}\right)\hat{k}$
 b) $-\left(\frac{20y}{z}\right)\hat{i} - \left(\frac{20x}{z}\right)\hat{j} + \left(\frac{20xy}{z^2}\right)\hat{k}$
 c) $-\left(\frac{20y}{z}\right)\hat{i} - \left(\frac{20x}{z}\right)\hat{j} - \left(\frac{20xy}{z^2}\right)\hat{k}$
 d) $\left(\frac{20y}{z}\right)\hat{i} + \left(\frac{20x}{z}\right)\hat{j} - \left(\frac{20xy}{z^2}\right)\hat{k}$

57. Two inclined friction tracks, one gradual and the other steep meet at A from where two stones are allowed to slide down from rest, one on each track as shown in figure. Which of the following statements is correct ?

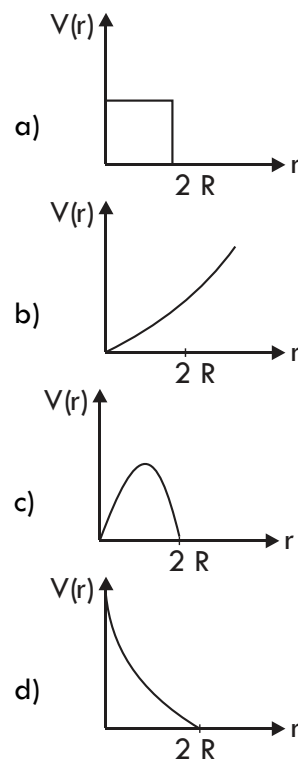


- a) Both the stones reach the bottom at the same time but not with the same speed
 b) Both the stones reach the bottom with the same speed and stone I reaches the bottom earlier than stone II.

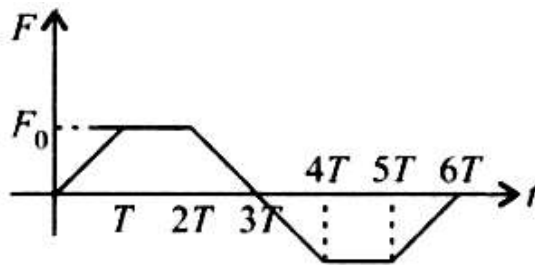
- c) Both the stones reach the bottom with the same speed and stone II reaches the bottom earlier than stone I.
 d) Both the stones reach the d

58. Which of the following potential energy curves possibly describes the elastic collision of two billiard balls each of radius R ?

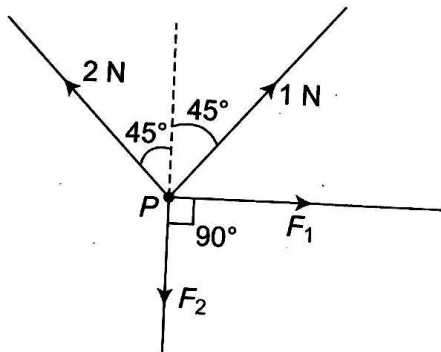
Here r is the distance between centres of the balls.



59. A particle of mass m experience a force that varies with time as shown. If the particle was at rest at $t = 0$. Find the velocity of the particle at the end of time $t = 3T$

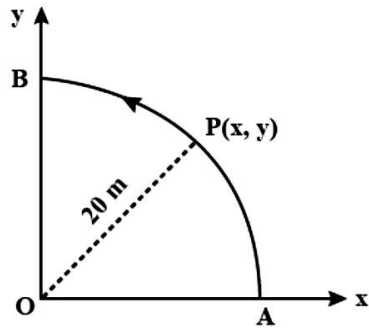


- a) $2TF_0$
 b) $\frac{TF_0}{m}$
 c) $\frac{2TF_0}{m}$
 d) $\frac{3F_0T^2}{2m}$
60. There are four forces acting at a point P produced by strings as shown in figure, which is at rest. The forces F_1 and F_2 are



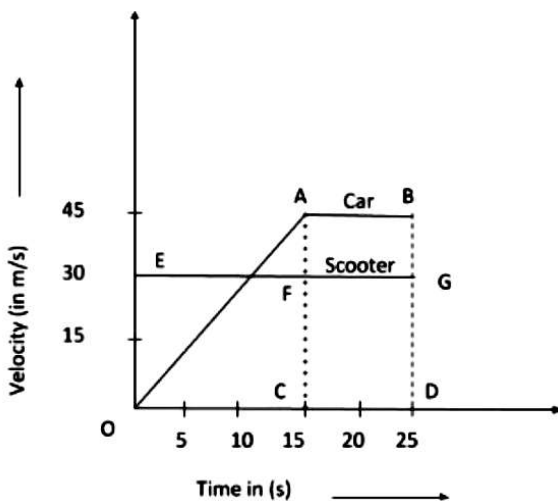
- a) $\frac{1}{\sqrt{2}}N, \frac{3}{\sqrt{2}}N$
 b) $\frac{3}{\sqrt{2}}N, \frac{1}{\sqrt{2}}N$
 c) $\frac{1}{\sqrt{2}}N, \frac{1}{\sqrt{2}}N$
 d) $\frac{3}{\sqrt{2}}N, \frac{3}{\sqrt{2}}N$

61. The range of the projectile projected at an angle of 15° with horizontal is 50 m. If the projectile is projected with same velocity at an angle of 45° with horizontal, then its range will be
- a) 50 m
 b) 100 m
 c) $50\sqrt{2}$ m
 d) $100\sqrt{2}$ m
62. A point P moves in counter-clockwise direction on a circular path as shown in the figure. The movement of P is such that it sweeps out a length $s = t^2 + 5$, where s in metres and t is in seconds. The radius of the path is 20 m. The acceleration of P when $t = 2$ s is nearly



- a) 14 m/s^2
- b) 13 m/s^2
- c) 12 m/s^2
- d) 7.2 m/s^2

63. The velocity - time graphs of a car and a scooter are shown in the figure. (i) The difference between the distance travelled by the car and the scooter in 15 s and (ii) the time at which the car will catch up with the scooter are, respectively



- a) 112.5 m and 15 s
- b) 337.5 m and 25 s

- c) 225.5 m and 10 s
- d) 112.5 m and 22.5 s

64. At a metro station, a girl walks up a stationary escalator in time t_1 . If she remains stationary on the escalator, then the escalator take her up in time t_2 . The time taken by her to walk up on the moving escalator will be

- a) $\frac{t_1 + t_2}{2}$
- b) $\frac{t_1 t_2}{t_2 - t_1}$
- c) $\frac{t_1 t_2}{t_2 + t_1}$
- d) $t_1 - t_2$

65. A particle moves rectilinearly. Its displacement x at time t is given by $x^2 = at^2 + b$ where a and b are constants. Its acceleration at time t is proportional to

- a) $\frac{1}{x^3}$
- b) $\frac{1}{x} - \frac{1}{x^2}$
- c) $-\frac{t}{x^2}$
- d) $\frac{1}{x} - \frac{t^2}{x^3}$

66. The equation of stationary wave is

$$y = 2a \sin\left(\frac{2\pi nt}{\lambda}\right) \cos\left(\frac{2\pi x}{\lambda}\right).$$

Which of the following is not correct ?

- a) The dimensions of n is $[LT^{-1}]$
- b) The dimensions of x is $[L]$
- c) The dimensions of nt is $[L^1]$
- d) The dimensions of $\frac{n}{\lambda}$ is $[T]$

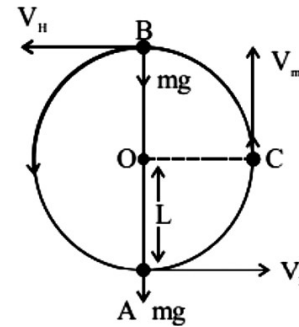
67. If momentum (p), area (A) and time (t) are taken to be fundamental quantities, then energy has the dimensional formula

- a) $[p^1 A^{-1} t^{-1}]$
- b) $[p^2 A^1 t^1]$
- c) $[p^1 A^{-1/2} t^1]$
- d) $[p^1 A^{1/2} t^{-1}]$

68. The coefficient of friction between the tyres and the road is 0.1. The maximum speed with which a cyclist can take a circular turn of radius 3 m without skidding is
(Take $g = 10 \text{ m s}^{-2}$)

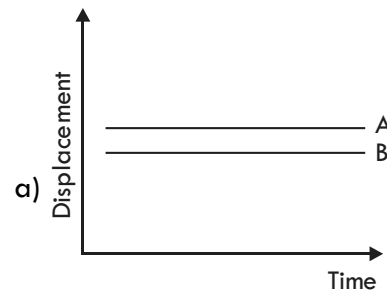
- a) $\sqrt{15} \text{ m s}^{-1}$
- b) $\sqrt{3} \text{ m s}^{-1}$
- c) $\sqrt{30} \text{ m s}^{-1}$
- d) $\sqrt{10} \text{ m s}^{-1}$

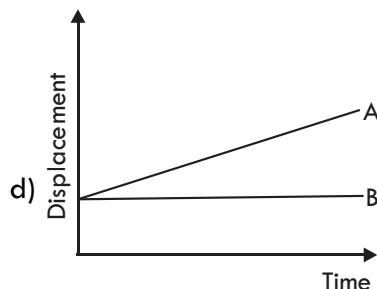
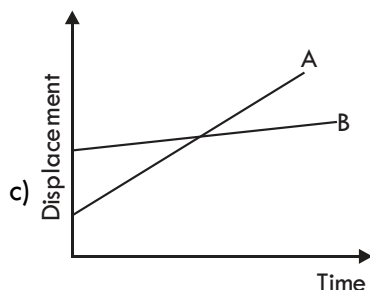
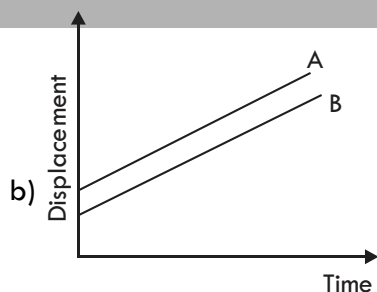
69. A bob of mass ' m ' is suspended by a light string of length ' L '. It is imparted a minimum horizontal velocity at the lowest point A such that it just completes half circle reaching the top most position B. The ratio of kinetic energies $\frac{(K.E.)_A}{(K.E.)_B}$ is



- a) 3 : 2
- b) 1 : 5
- c) 2 : 5
- d) 5 : 1

70. Which one of the following represents displacement - time graph of two objects A and B moving with zero relative velocity ?





71. A mixture of MgCO_3 and CaCO_3 was heated for a long time, the weight is decreased by 50%. The percentage composition of MgCO_3 and that of CaCO_3 in the mixture will be respectively

- a) 28.5% and 71.5%
- b) 84% and 16%
- c) 71.5% and 28.5%
- d) 44.5% and 55.5%

72. The electronic transition from $n = 2$ to $n = 1$ will produce shortest wavelength in

- a) H-atom
- b) D-atom
- c) He^+ ion
- d) Li^{2+} ion

73. Which of the following sets of quantum numbers represents the highest energy of an atom?

- a) $n = 3, l = 0, m = 0, s = +1/2$
- b) $n = 3, l = 1, m = 1, s = +1/2$
- c) $n = 3, l = 2, m = 1, s = +1/2$
- d) $n = 4, l = 0, m = 0, s = +1/2$

74. Which of the following statements is not correct about the characteristics of cathode rays?

- a) They start from the cathode and move towards the anode.
- b) They travel in straight line in the absence of an external electrical or magnetic field.
- c) Characteristics of cathode rays do not depend upon the material of electrodes in cathode ray tube.
- d) Characteristics of cathode rays depend upon the nature of gas present in the cathode ray tube.

75. The probability of finding out an electron at a point within an atom is proportional to the

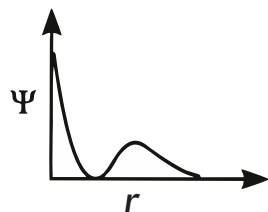
- a) square of the orbital wave function i.e., Ψ^2
- b) orbital wave function i.e., Ψ
- c) Hamiltonian operator i.e., H
- d) principal quantum number i.e., n

76. Match the values of column II with column I and mark the appropriate choice.

Column I		Column II	
(A)	Mass of electron	(i)	1.673×10^{-27} kg
(B)	Mass of proton	(ii)	-1.602×10^{-19} C
(C)	Charge of electron	(iii)	9.1×10^{-31} kg
(D)	e/m for an electron	(iv)	1.76×10^8 C/g

- a) (A) $\rightarrow$ (i), (B) $\rightarrow$ (ii), (C) $\rightarrow$ (iv), (D) $\rightarrow$ (iii)
- b) (A) $\rightarrow$ (iii), (B) $\rightarrow$ (i), (C) $\rightarrow$ (ii), (D) $\rightarrow$ (iv)
- c) (A) $\rightarrow$ (ii), (B) $\rightarrow$ (iii), (C) $\rightarrow$ (iv), (D) $\rightarrow$ (i)
- d) (A) $\rightarrow$ (i), (B) $\rightarrow$ (iii), (C) $\rightarrow$ (ii), (D) $\rightarrow$ (iv)

77. The graph between $|\Psi|^2$ and r (radial distance) is shown below. This represents.



- a) 3s orbital
- b) 2p orbital

- c) 1s orbital
- d) 2s orbital.

78. Oxygen occurs in nature as a mixture of isotopes ^{16}O , ^{17}O and ^{18}O having atomic masses of 15.9995 u, 16.999 u and 17.999 u and relative abundance of 99.763%, 0.037% and 0.200% respectively. What is the average atomic mass of oxygen?

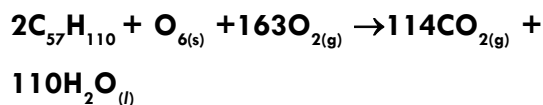
- a) 15.999 u
- b) 16.999 u
- c) 17.999 u
- d) 18.999 u

79. The ratio of mass percent of C and H of an organic compound ($\text{C}_x\text{H}_y\text{O}_z$) is 6 : 1. If one molecule of the above compound ($\text{C}_x\text{H}_y\text{O}_z$) contains half as much oxygen as required to burn one molecule of compound C_xH_y completely to CO_2 and H_2O the empirical formula of compound $\text{C}_x\text{H}_y\text{O}_z$ is

- a) $\text{C}_3\text{H}_6\text{O}_3$
- b) $\text{C}_2\text{H}_4\text{O}$
- c) $\text{C}_3\text{H}_4\text{O}_2$
- d) $\text{C}_2\text{H}_4\text{O}_3$

80. For the following reaction, the mass of water produced from 445 g of $\text{C}_{57}\text{H}_{110}\text{O}_6$ is

Rough Work



- a) 490 g
b) 495 g
c) 445 g
d) 890 g

81. Match the column I with column II and mark the appropriate choice.

Column I		Column II	
(A)	Mass of H_2 produced when 0.5 mole of zinc reacts with excess of HCl	(i)	3.01×10^{23} molecules
(B)	Mass of all atoms of a compound with formula $\text{C}_{70}\text{H}_{22}$	(ii)	6.023×10^{23} molecules
(C)	Number of molecules in 35.5 g of Cl_2	(iii)	1.43×10^{-21} g
(D)	Number of molecules in 64 g of SO_2	(iv)	1 g

- a) (A) $\rightarrow$ (ii), (B) $\rightarrow$ (i), (C) $\rightarrow$ (iv), (D) $\rightarrow$ (iii)
b) (A) $\rightarrow$ (i), (B) $\rightarrow$ (ii), (C) $\rightarrow$ (iii), (D) $\rightarrow$ (iv)
c) (A) $\rightarrow$ (iv), (B) $\rightarrow$ (iii), (C) $\rightarrow$ (i), (D) $\rightarrow$ (ii)
d) (A) $\rightarrow$ (iv), (B) $\rightarrow$ (iii), (C) $\rightarrow$ (ii), (D) $\rightarrow$ (i)

82. The most abundant elements by mass in the body of a healthy human adult are : oxygen (61.4%), carbon (22.9%), hydrogen (10.0%) and nitrogen (2.6%). The weight which a 75 kg person would gain if all ^1H atoms are replaced by ^2H atoms is

a) 7.5 kg
b) 10 kg

- c) 15 kg
d) 37.5 kg

83. Which of the following is a chemical fertilizer?

- a) Urea
b) Sodium nitrate
c) Ammonium sulphate
d) All of these

84. Which of the following order is correct?

- a) $\text{AlCl}_3 < \text{MgCl}_2 < \text{NaCl}$: Polarising power
b) $\text{CO} > \text{CO}_2 > \text{HCO}_2^- > \text{CO}_3^{2-}$: Bond length
c) $\text{BeCl}_2 < \text{NF}_3 < \text{NH}_3$: Dipole moments
d) $\text{H}_2\text{S} > \text{NH}_3 > \text{SiH}_4 > \text{BF}_3$: Bond angle

85. Which of the following statements about CO_3^{2-} ion is correct?

- a) The C–O bond order is 1.5.
b) The formal charge on each oxygen atom is –0.67.
c) It has two C–O single bonds and one C=O double bond.
d) The hybridization of central atom is sp^3 .

86. Statement I : H_2^- is paramagnetic in nature.

Statement II : H_2^- has one unpaired electron in antibonding molecular orbital.

- a) Both statement I and statement II are true and statement II is the correct explanation of statement I.
- b) Both statement I and statement II are true but statement II is not the correct, explanation of statement I.
- c) Statement I is true but statement II is false.
- d) Both statement I and statement II are false.

87. Given below is the table showing shapes of some molecules having lone pairs of electrons. Fill up the blanks left in it.

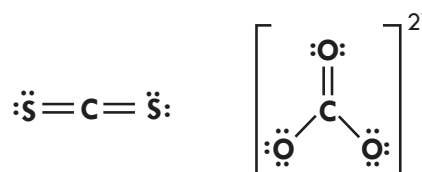
Molecule type	bp	lp	Shape	Example
AB_2E_2	2	<u>P</u>	Bent	H_2O
AB_3E_2	3	<u>2</u>	<u>Q</u>	ClF_3
AB_5E	5	<u>R</u>	<u>S</u>	BrF_5
AB_4E_2	4	<u>2</u>	<u>T</u>	U

	P	Q	R	S	T	U
a)	2	Square Pyramidal	2	T-Shaped	Square Planar	H_2O_2
b)	4	T-Shaped	5	Square Planar	Square Pyramidal	SO_3
c)	2	T-Shaped	1	Square Pyramidal	Square Planar	XeF_4
d)	2	Square Planar	2	T-Shaped	Square Pyramidal	$BrCl_3$

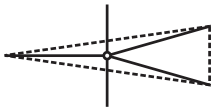
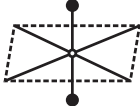
88. Two elements X and Y combine to form a compound XY. Under what conditions the bond formed between them will be ionic?

- (a) If the difference in electronegativities of X and Y is 1.9.
- (b) If the difference in electronegativities of X and Y is more than 1.9.
- (c) If the difference in electronegativities of X and Y is less than 1.9.
- (d) If both X and Y are highly electronegative.

89. What is the formal charge on carbon in the following two structures ?



- a) 0, -2
- b) 0, 0
- c) +0, -2
- d) +1, -1
90. Match the molecules given in column I with their shapes given in column II and mark the appropriate choice.

Column I (Molecule)		Column II (Shape)	
(A)	SF_6	(i)	
(B)	SiCl_4	(ii)	
(C)	AsF_5	(iii)	
(D)	BCl_3	(iv)	

- a) (A) $\rightarrow$ (iv), (B) $\rightarrow$ (ii), (C) $\rightarrow$ (iii), (D) $\rightarrow$ (i)
 b) (A) $\rightarrow$ (iv), (B) $\rightarrow$ (i), (C) $\rightarrow$ (ii), (D) $\rightarrow$ (iii)
 c) (A) $\rightarrow$ (iii), (B) $\rightarrow$ (i), (C) $\rightarrow$ (ii), (D) $\rightarrow$ (iv)
 d) (A) $\rightarrow$ (ii), (B) $\rightarrow$ (iii), (C) $\rightarrow$ (i), (D) $\rightarrow$ (iv)

91. Assertion: Helium has the highest value of ionisation energy among all the elements known. **Reason** Helium has the highest value of electron affinity among all the elements known.

- a) If both assertion and reason are true and reason is the correct explanation of assertion among all the elements known.
 b) If both assertion and reason are true but reason is not the correct explanation of assertion.
 c) If assertion is true but reason is false.
 d) If both assertion and reason are false.

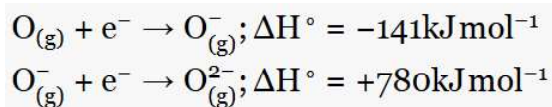
92. The element with $Z=120$ (not yet discovered) will be an/a

- a) inner-transition metal
 b) alkaline earth metal
 c) alkali metal
 d) transition metal.

93. Which of the following sets of oxides is amphoteric in nature?

- (a) Al_2O_3 , As_2O_3 , ZnO
 (b) CO , NO , N_2O
 (c) SO_3 , SO_2 , Cl_2O_7
 (d) Na_2O , MgO , BaO

94. The formation of the oxide ion, from oxygen atom requires first an exothermic and then an endothermic step as shown below:



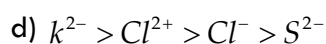
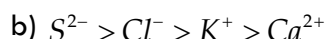
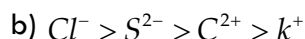
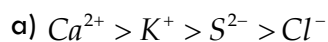
Thus process of formation of O^{2-} in gas phase is unfavourable even though O^{2-} is isoelectronic with neon. It is due to the fact that,

- a) oxygen is more electronegative
 b) addition of electron in oxygen results in larger size of the ion.
 c) electron repulsion outweighs the stability gained

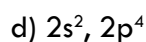
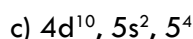
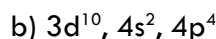
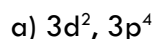
by achieving noble gas configuration

d) O^- ion has comparatively smaller size than oxygen atom.

95. The correct order of the decreasing ionic radii among the following isoelectronic species is



96. Element "E" belongs to the period 4 and group 16 of the periodic table. The valence shell electron configuration of the element which is just above "E" in the group is



97. The IUPAC name of an element with atomic number 119 is

a) ununennium

b) unnilennium

c) unununnium

d) ununoctium

98. How many number of molecules and atoms respectively are present in 2.8 litres of a diatomic gas at STP?

a) $6.023 \times 10^{23}, 7.5 \times 10^{23}$

b) $6.023 \times 10^{23}, 15 \times 10^{22}$

c) $7.5 \times 10^{22}, 15 \times 10^{22}$

d) $15 \times 10^{22}, 7.5 \times 10^{23}$

99. Calculate molarity of 63% w/w HNO_3 solution if density is 1.4 g/mL.

a) 14 M

b) 12 M

c) 10 M

d) 8 M

100. The Bohr's energy of a stationary state of hydrogen atom is given as $E_n = \frac{-2\pi^2 m e^4}{n^2 h^2}$. Putting the values of m and e for n^{th} energy level which is not the correct value?

a) $E_n = \frac{-21.8 \times 10^{-19}}{n^2} J \text{ atom}^{-1}$

b) $E_n = \frac{-13.6}{n^2} eV \text{ atom}^{-1}$

c) $E_n = \frac{-1312}{n^2} kJ \text{ mol}^{-1}$

d) $E_n = \frac{-12.8 \times 10^{-19}}{n^2} \text{erg atom}^{-1}$

[illegible]

[illegible]